Art of Grafting in India.

By

G. B. Set., B. A., F. R. H. S. (Lond.)

IVY NURSERY GARDENS.
108, Ultadanga Main Road,
CALCUTTA.

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Dedication Page.

As a token of sincerest gratitude for their most encouraging letters, kind help and patronage to my business, this book is dedicated to—

1. The Hon'ble Maharajadhiraj Bahadur of Burdwan.
2. The Sri Raja of Pithapuram Estate, Pithapuram.
3. Raja Nerode Chundra Sinha of Shusang.
4. Sj. Hem Sankar Roy, Zamindar, Teota, Dacca.
5. Hon'ble Mr. Dubern, Legislative Council, Burma.
6. Hon'ble Rao Bahadur D. B. Parasnis, Happy Vale, Satara.
7. Mrs. H. Adamson, Gopalichak, Jharia.
8. Mrs. H. C. Veasy, Gonda House, Ranchi.
9. Mrs. & Mr. Martinelli, 24, Ekbalpore Road, Kidderpore, Calcutta.
10. Mrs. & Mr. Lord, Morphett Vale, 58, Barrackpore Trunk Road, Cossipore, Calcutta.
11. T. F. Smithers Esq., B. D. Ry., Domohani.
12. Rev. Father Romulus, O. C., St. Francis Church, Dehra Dun.

—AND—

To all of my beloved and esteemed customers whose names (although omitted here for want of space) are and shall be always in my loving memory.

PREFACE.

A majority of Gardeners and Agriculturists in India, I am sorry to observe, are quite ignorant of the various processes how plants may be multiplied. True it is, that some possess very vague and imperfect notions of the art of grafting, but in most cases, their knowledge is only superficial, being based upon the writing of some equally impractical author, who has, I am afraid, never himself tried any grafts practically in his whole life. Such a theoretical knowledge is often dangerous, as it tends more to destroy the mother than preserving her progeny.

Practical nurserymen and actual propagators of plants have always reserved to themselves the right of knowledge of this important art, which they guard cautiously as a **trade secret.** This narrowmindedness—this selfish motive—has been surely a great bar in the way of Agricultural progress and development of the country, and Agri—Horticultural resources of the Government. How many valuable plants in the famous gardens of Nawab Tipu Sultan or in those of the Nawab of Murshidabad have now become quite extinct and exotic, simply through ignorance of this important art and the impossibility of procuring a number of trained men for the purpose ! Nature has lavished upon our country her bountiful gifts in Flower, Fruit and Economic Plants. Although the art of Pollination and Hybridisation are things totally unknown in this country, the work of the artificial raiser, is done here by Nature herself in spontaneous production of a new species found so often in a domestic garden in India. To preserve that species and to multiply it, the gardener must have a sound knowledge of this important art, without which he can never expect to add to the Agri—Horticultural resources of the Country, benefitting not only himself but the General Public and the Government.

Forest Officers, Superintendents of Public Gardens, Estates and Municipalities, as well as every Planter living in far distant and out-of-way places from a *bona fide* Nursery establishment, will undoubtedly find this little book an immense help in equipping their resources without any great trouble or expenditure. Every Mofussil gardener may reduce his Nurseryman's Bill by 75%, when he has acquired a practical knowledge of the art of grafting, and has succeeded in multiplying his own plants in his own domestic garden.

In making this publication, it has been the sincerest aim of the author to divulge a long-kept secret, and although he must admit that by so doing he has no doubt betrayed his fellow Nurserymen, he begs to assert that he has been actuated by far nobler principles and by still higher aspirations of helping the General Public, not merely for their own individual benefit, but for the general good and advancement of the country to which they belong.

108, Ultadanga Main Road,
Calcutta,
Dated the 25th. July, 1920.

G. B. SET.

MEANING OF A GRAFT.

As understood by every practical gardener, the word "Graft" is a general term, comprising "Cutting" "Layering", "Gootee" or "Ball-Grafting", "Inarching" "Budding", and "Separation by Division". In fact, it comprises all the various methods by which a practical gardener multiplies his plants, **except by using "Seeds"**, which produce "**Seedlings**" and not "**Grafts**". A Graft may, therefore, be defined from a Nurseryman's point of view, to be a plant, which has been raised **not from Seeds.**

To a popular notion (and specially in Medical Science), the processes like those of "Inarching" and "Budding" are only accepted as Grafts-in-proper, althougsh some agree to add "Gootee" to the list. But none of the other three methods would be acceptible to an amateur as "Grafting". This notion should be discarded, at least by a practical gardener, as every one of the six methods mentioned above has the same ultirior object in view, namely, early cropping and maintaining the standard and quality of the crop of its mother. A "Seedling" plant, besides taking a much longer time to produce fruits or flowers, is very doubtful of **yielding the same standard and quality of the crop**, sometimes improving and sometimes degenerating, or varying in other ways, according to the special influences under which the seed was formed in its original mother. In a "Graft", the **Standard** of the mother is always maintained, besides **gaining of time**.

It is also a wrong notion with some people who believe that fruits or flowers are **improved** by Grafting. Far from it. By Grafting, as I have already stated, time is only gained and permanency of the mother is maintained, no question of improvement or degeneration should arise. The latter two are effected either naturally, or artificially by raisers of new crops.

CUTTING.

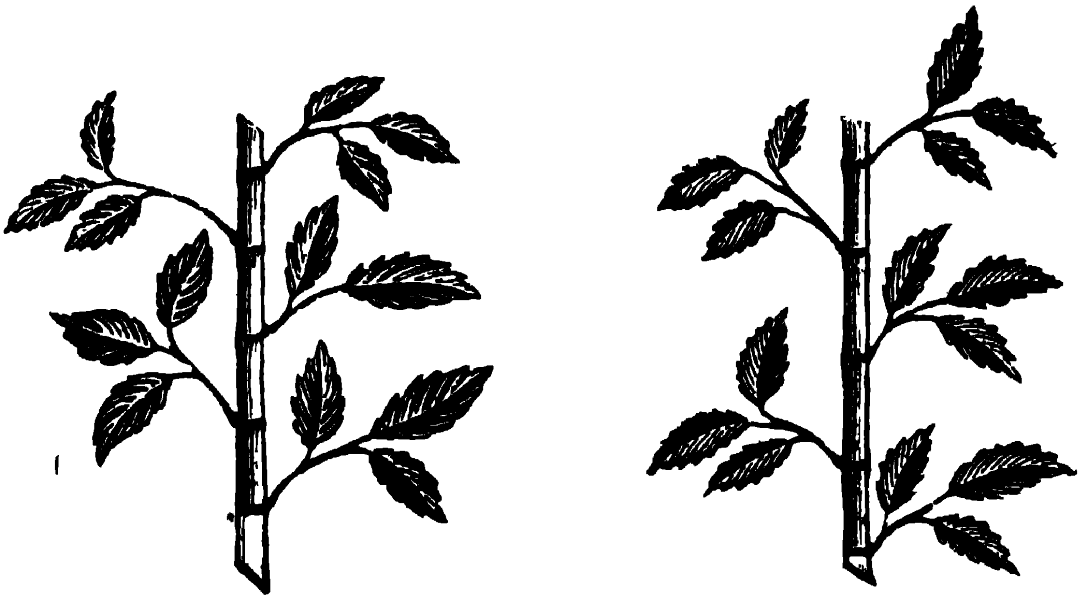
Cutting is the easiest mode of propagating certain plants. By "Cutting" is meant cutting the twig of a mother plant and inserting it in the ground, which in course of time "strikes" *i. e.*, takes roots, and becomes a separate independent plant in itself.

The instruments necessary for a Cutting, are a sharp knife, or a pair of Garden Scissors (usually called by gardeners Shears or Secateurs). If you have no garden shears, or donot wish to purchase one, only procure a sharp knife, and this will be enough for your ordinary purposes.

To make a successful cutting, the following general instructions are to be carefully noted :—

1. **How a twig is to be cut before inserting it in the ground.**—In twigs of almost every plant, you will find knots or joints at certain intervals, where "eyes" of plants are located, and just from these points fresh branches and leaves (technically called in gardening "Leaf-Buds") grow. It is at any of these points that roots can be made to grow. Take some twigs or branches of a mother plant, whose cuttings you desire to make. These twigs are then to be subdivided into smaller twigs, say about 6 to 9 inches long, **taking care that the bottom part of every such minor twig is cut just below any one of the knots.** It is also better and desirable that the upper part is also cut **just above** the knot, although the last is not absolutely necessary. (If a branch is cut at random without noting the above instructions, a great percentage will fail to strike). In next page give illustrations showing wrong and correct Cuttings ready for striking.

Fig. 1.



Wrong cutting Correct cutting.

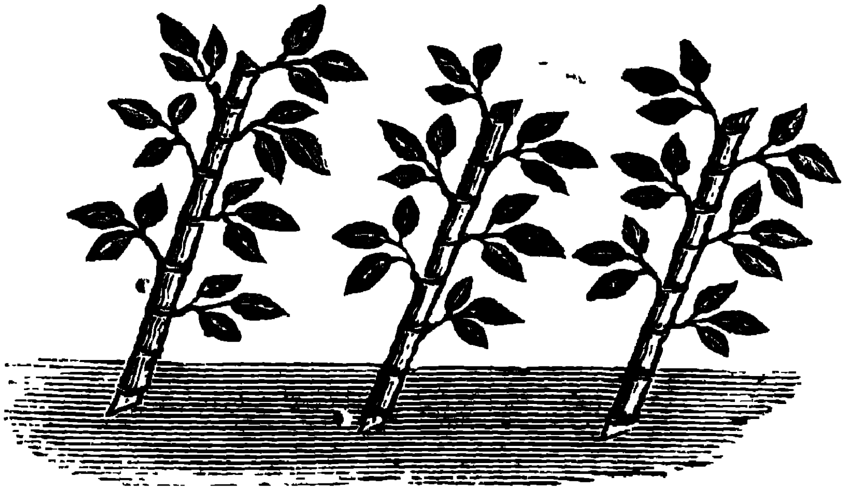
2. Soil for Cuttings.—Any average garden soil will suit a Cutting to strike. A partially shady place will be the most appropriate site for inserting Cuttings, as under a tree, or just near the partial shade of a wall or building, but if no such place be available, you are to protect the newly inserted Cuttings by shading them artificially from mid-day sun by some suitable coverings prepared for the purpose, allowing only morning and setting rays and night dews. It should be also noted that your bed for Cuttings must be well drained. First stir up the soil with a *kodali* to a depth of about 9 inches. Let it partially dry up for a day or two, after which the big fragments of earth are to be broken up and well pulverized by means of a bamboo hammer or some such suitable instruments. To render it still more fine, loose and light, use your both hands, and break off still remaining bits of earth, removing all *khoas*, bits of stones or any other hard things that may be found mixed up with your soil. Then gently moisten it with water, when the ground will be ready to receive Cuttings immediately.

A bed for Cuttings should, in no way, be *manured*. A manured soil is almost sure to ruin your Cuttings. They will never strike, but shrivel up, rot and perish. Newly inserted Cuttings are to be looked upon, as if so many human beings suffering from some dangerous illness, who can never assimilate rich and substantial food, which if given would most likely kill the patient. They are to be prescribed only sick-diet, and an ordinary garden soil prepared in the above manner, is the most appropriate food for Cuttings to subsist upon before striking, *e. i.* taking root.

Recent Horticultural Science strongly recommends a gardner to add some quantity of well powdered charcoal (say 10%) to the soil intended for Cuttings. The use of charcoal as a wonderful medium for striking Cuttings has been demonstrated my Mr. A. Appleyard, M. Sc., of Rothamstead Experimental Station in a lecture recently delivered by the gentleman before the Members of the Royal Horticultural Society, London. (See R. H. S. Journal, April, 1915, Vol. XL, Part 3). The scientific explanation for the use of this specific is to be found in the fact that charcoal keeps the soil often open and porous, thereby preventing sourness and clamminess after heavy rains or excessive watering. By using charcoal the soil is rendered "sweet" for a long time. Further, charcoal absorbs Carbon Dioxide and Ammonia, and these dissolved in water are easily assimilated by the Cuttings, thus encouraging growth of roots in shortest time.

3. Mode of inserting Cuttings.—All Cuttings strike more readily if they are put in the ground in a little inclined position than placing them quite erect or vertically. If they are put at an angle of 60 degrees, *i. e.,* at an angle which an equilateral triangle makes, they would strike most advantageously. But the gardener need not trouble himself

Fig. 2.



to be too much precise in this respect. He should simply see that they are put **inclined,** neither too much, nor too little. An inclination as shown in Fig. 2, would give an idea of how to place them in beds for Cutting. Strip off all leaves from the bottom knots or joints, *i. e.*, those leaves which will lie inside the ground when they are inserted in beds. The remaining leaves of the Cutting will also naturally fall off shortly after their insertion, leaving them as so many bare but green sticks. Every Cutting should be put in the ground more or less 2 inches deep, taking care that the natural upper part of the twig remains in an upward position, and the natural lower part remains downward. If a Cutting is put **topsy turvy** against law of nature, it will not strike at all, except with extreme difficulty under most favourable circumstances. As soon as Cuttings are inserted, their bed is to be liberally supplied with water, and this continued at intervals of a day or two, *i. e.*, as often as the bed is dry.

4. Time required for a Cutting to strike.—Some Cuttings strike more easily than others. The average time for a Cutting to strike is from 4 to 6 weeks, although some strike earlier and some later under special circumstancial influences. The first sign of a cutting being just on the point of striking is, in the growth of new shoots or leaves in your inserted twig. But even at this time you should not be assured of the roots having actually grown. This is the time when their bottom parts are covered with a thick spongy substance, which is an indication that your Cuttings are **about to strike**. When the shoots and leaves have grown a little bigger, you will be sure that roots **must have grown**, and waiting for another fortnight (in order to allow the new and delicate roots to become more hardy), they may be safely transplanted in pots or other suitable beds intended for them.

5. Some Miscellaneous Hints on Striking. In Plains of India, Cuttings should be made either during rains or in winter. They should never be attempted during hot months of the year, when Cuttings cannot remain green for a long time, and consequently dry up before striking. The underlying principle of a successful striking is, that it should be any how managed to keep green for a certain period of time, and if this can be effected with success, Cuttings are sure to strike. In this respect, they may be aptly compared to some Hospital patient suffering from a dangerous type of Typhoid fever. If, by careful nursing and treatment, the patient can be made to push through a certain period of time, ninety per cent of the danger is over, and he gradually comes round. Exactly is the case with Cuttings.

If the twig, by a careful and judicious handling is, any how kept green for a certain length of time, roots are sure to grow. Cuttings of some plants remain green (without rotting) for a longer time during winter than during rains. Cuttings of such plants should, therefore, be made during winter months, and not in rains. Again, there are other plants, twigs of which remain green (without drying up) during rainy season for a longer period of time than during winter. Cuttings of such plants should, therefore, be attempted during rains and not in winter. In other words, Cuttings of plants which have a tendency to **rot easily** should be attempted during winter, and those that have a tendency to **dry up** easily, should be made during rains. Roses & Chrysanthemums, Geraniums & Lavenders have a tendency more of **rotting** than of **drying up**; hence, their Cuttings should he made in winter. Crotons & Dracaenas, Durantas & Lawsonia (Indian Myrtle) dry up more easily than rotting, and hence their Cuttings should be always made during rains. In the following pages, I give a List of Plants, whose Cuttings are ordinarily made in a Nursery Garden, giving their respective times for propagation :—

1. CUTTINGS FOR WINTER,

1. Aloysia Citriodora (Lemon-Scented Verbena).
2. Aurundo Donax (Both China & Indian).
3. Barleria.
4. Chrysanthemums (Perennial).
5. Dahlias.
6. Euphorbia Bojerii.
7. Geranium (Both Flowering & Scented)
8. Goldfussia.
9. Hamiltonia.
10. Hasu-nu-hena.
11. Lavender.
12. Pear (Fruit Plant).
13. Photinia.
14. Plumbago (Blue).
15. Poinsettia Pulcherrima (Both white & Red).
16. Roses (Cape or Edward, Arch Duke Charles. (Do-Runga), Gigentia, Duc de Berri, China Rose and Rosa Multiflora).

2. CUTTINGS FOR RAINY SEASON.

1. Acalypha.
2. Aloocha & Aloobokhara (Fruits).
3. Allamanda. Cathertica.
4. Allamda Nerifolia.
5. Alternanthera.
6. Antigonon,
7. Aralia.

8. Aristolochia.
9. Balsamodendron Roxburghii (Economic Tree).
10. Barberry.
11. Barringtonia.
12. Bella.
13. Bignonia.
14. Bridal Creeper.
15. Cactus.
16. Calicarpa Arborea.
17. Chameli.
18. China Grass.
19. Cissus Discolour.
20. Coleus.
21. Cowslip Creeper.
22. Clerodendron.
23. Crescentia Cujute (Big hard-skinned fruits; a native musical instrument called "Tanpura" is made from its skin)
24. Crossandra-
25. Crotons.
26. Dombeya.
27. Dracaena.
28. Duranta.
29. Erythrina (Parijat).
30. Figian Fire Plant.
31. Flowering Cherry (Indian)
32. Gardenia (Both Grandiflora & Lucida).
33. Grapes or Vines.

34. Guava, China.
35. Hibiscus (Jawa).
36. Hibiscus Mutabilis (Sthal Padma, Rose of Sharon)
37. Honey Suckle.
38. Hoya.
39. Ipomoea.
40. Ixora.
41. Jasmine (Both English & Indian).
42. Jatropha (Coral Plant)
43. Lagerstromia.
44. Lantana.
45. Lawsonia Alba (Indian Myrtle, Mehndi)
46. Libonia.
47. Lime, Sarbutti (Fruit Plant).
48. Malpighia.
49. Marigold.
50. Memeceylcn.
51. Meyenia.
52. Mulberry (Fruit Plant)
53. Mussaenda.
54. Nerium, or Oleander (Karubi)
55. Panax.
56. Passiflora.
57. Peppermint.
58. Pudina.
59. Plumbago (White & Red)
60. Pothos.

61. **Pogostemon Patchouli** (*Putcha Pat*)
62. **Rondelatia.**
63. **Russelia Floribunda.**
64. **Salvia Splendens** (*White*).
65. **Strobilanthes.**
66. **Tabernaemontana** (*Tagar*).
67. **Tecoma Jasminides.**
68. **Weeping Willow (Avenue Tree).**

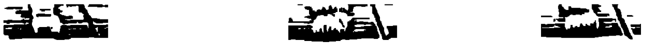
P. S.—In Hill Stations, Cuttings should be made in spring, summer or rainy seasons, *but not in winter.*

LAYERING.

By "Layering" is meant bending down to the earth a ripened twig of a mother plant and covering it over with earth two or three inches deep, the covered portion generally undergoing some surgical operations to facilitate an easy growth of roots in the covered parts of the twig. Propagation by Layering is a slower but surer process than by Cuttings, and often resorted to in case of comparatively valuable plants, or which are more delicate in their nature.

The first essential thing for a Layer is to prepare a bamboo pin or peg, by means of which the twig is artificially bent down to the earth without breaking. Bamboo pins or pegs are made in the following way. Take a bamboo. First, cut it to pieces, say 8 to 10 inches each, retaining one joint in each, dividing the piece at points a, b, c (as shown in Fig. 3), and cutting at these points, you 'will get two smaller round bamboos, each with a joint at top, as shown in Fig. 4. By cutting these again lengthwise, you will get pegs or pins as shown in Fig. 5. Then take a sharp knife, and pass it halfway lengthwise, commencing from the bottom of each of such pins, where there is no joint, and stopping your knife a little below each upper knot, when you will get pins or pegs (as

Fig. 3.



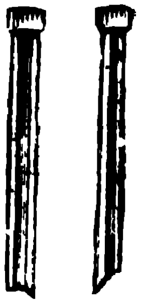


Fig. 4. **Fig. 5.** **Fig. 6.**

shown in Fig 6), ready for use in bending down your twigs.

Layers are of three kinds: **Simple, Compound** and **Complex**. In a **"Simple Layer",** the bent covered portion of the twig does not undergo any surgical operation, but simply covered over as it is, with earth. In a **"Compound Layer"** the bent covered portion is deprived of its outer skin just below one of the knots and extending it to a distance of say 1½ inch with a sharp knife, retaining only the inner wood at these points. In a **"Complex Layer",** the portion lying in the ground is slit longitudinally half and half, commencing just from the bottom of one knot and extending just below its upper one, the slit portion thus set asunder from the mother being called "Tongue" in Technical Gardening. This last one is always practised in a Nursery Garden, as it is surest and quickest in its results.

SIMPLE LAYERING.

Simple Layerings are effected very easily. Bend down the twig of the mother whose layer you intend to make to the earth with a bamboo peg as shown in

Fig. 7.

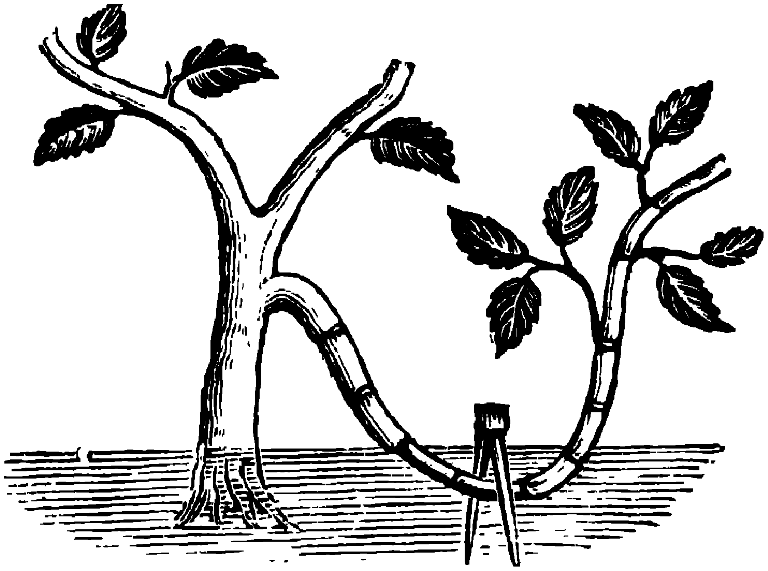


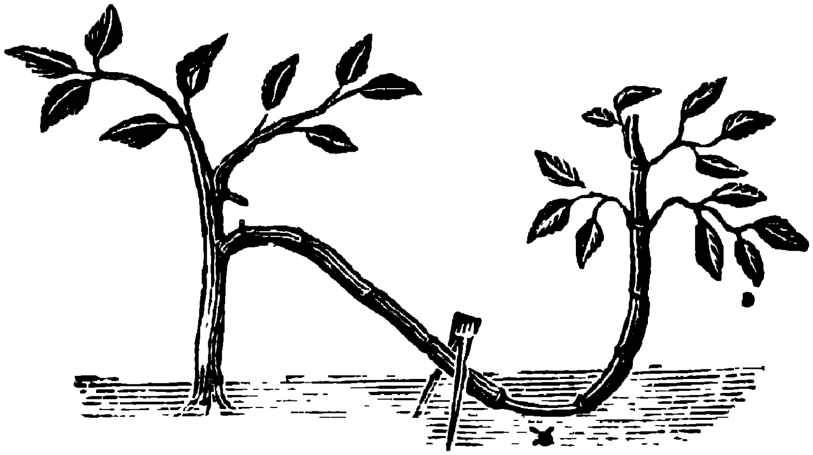
Fig. 7. Remove the earth where the twig meets the ground to a depth of 2 or 3 inches, and cover it over with an ordinary soil which should be pressed down and watered daily i. e., as often as the soil is dry. In course of time, roots will grow near one or more of the knots which lie under the ground.

The disadvatage of a Simple Layering is that roots generally grow very slowly, excepting a few plants like Crotons, Acalyphas, Piper Nigrum &c. Stephanotis Floribunda and Uveria Odorata have been found to strike by this method after a full period of one year and six months. For this reason, Simple Layering is never practically resorted to in a Nursery Garden, where consideration of time is of primary importance.

COMPOUND LAYERING.

In a Compound Layer, the branch whose Layer is to be made, is first bent down from the mother

Fig. 8.

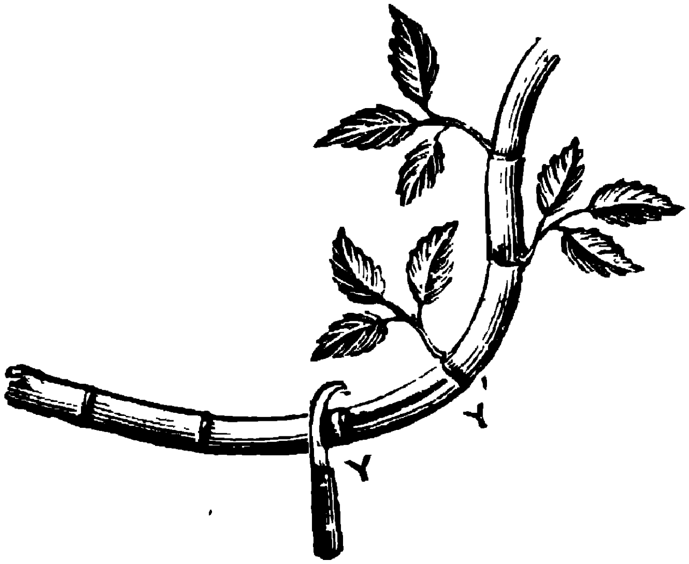


plant by a bamboo pin as shown in Fig. 8. The bent portion is scraped with a knife so as to take away only the skin just below one of the knots, and extended to a length of an inch and a half, retaining the interior wood as shown in part x of Fig. 8. It is then covered over with an ordinary garden soil as in the case of a Simple Layering, to a depth of 2 or 3 inches which should then be pressed down and watered daily, i. e., as often as the soil is dry. A Complex Layer as described below, is the quickest of all, in encouraging root growth.

COMPLEX LAYERING.

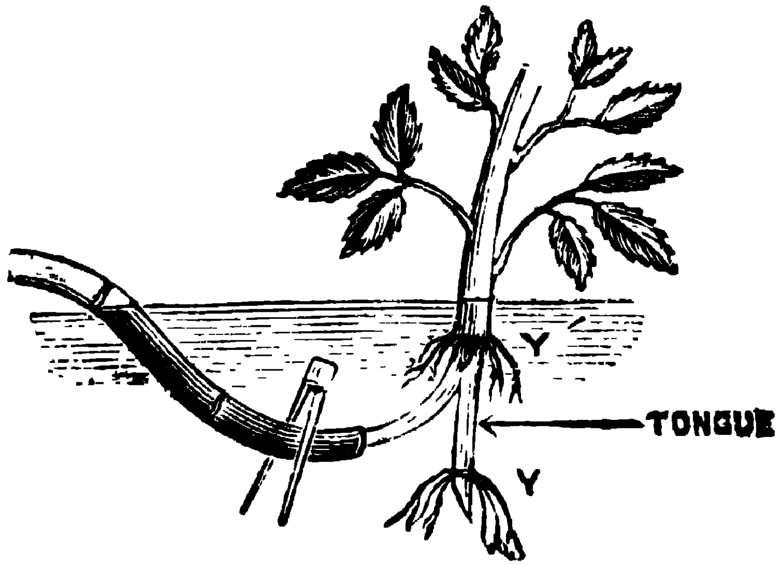
In Complex Layering, the first important thing is to understand clearly how the bent portion of the twig is slit longitudinally.

Fig. 9.



Take a knife, and put it at the bottom part of the bent portion, as shown in Fig. 9. Commence slitting lengthwise half and half from just below the lower knot y, extending it up to a piont just below its next upper knot y', where your knife is to be stopped. Set the twig properly by means of the bamboo peg as shown in Fig. 10, pressing the earth firmly to make the twig as erect as possible. The slit portion (the part from y to y' as shown in Fig. 10) is called "Tongue" of the Layer. Roots will grow both near the knots, y and y' and much more easily than either of the first two methods described above.

Fig. 10.



As regards covering it over with earth and watering, follow exactly as in the other two methods of Layering. In a Nursery Garden, now a days, Complex Layering is always resorted to. The other two methods are seldom used except by an amateur, whose consideration of time for striking may not be of any primary importance or consequence.

The average time for striking of a Layer may vary from 3 weeks to 4 months according to the nature of the plant layered. As for example, Piper Nigrum and Beaumontia Grandiflora will take 3 weeks during rains to strike, but Uveria Odorata or Stephanotis Floribunda will not strike till 4 or 5 months are over. All plants which can be propagated by Cutting, may naturally be propagated by Layering as well. But, there are certain plants which can seldom he multiplied by Cuttings, but can be successfully propagated by Layering. At least the percentage of failures in case of Layering is much less than in the case of Cuttings, and hence in case of comparatively valuable plants, it is advisable to adopt the method of Layering.

Layering may be made (excepting a very few plants whose Layers are made only in winter in Plains of India), during any season of the year, provided their bed is regularly watered, especially during hot and dry months of the year. In rainy season, the additional troubles and costs of watering are much minimised, and hence every professional gardener would prefer a rainy season to any other time of the year to layer his plants.

In next page, I give a List of plants which are generally propagated by Layering in a Nursery Garden.

LIST OF PLANTS GENERALLY LAYERED.

1. **Amherstia Nobilis.**
2. **Angelonia.**
3. **Antigonon Leptopus (Especially White)**
4. **Aristolochia (Valuable Sorts)**
5. **Aphelandra.**
6. **Apple.**
7. **Astrapaea Wallichii.**
8. **Banistaria Laurifolia.**
9. **Bauhinia.**
10. **Beaumontia Grandiflora.**
11. **Brownia Coccinea.**
12. **Brunsfelsia Americana.**
13. **Camphora Officinalis.**
14. **Caesalpinia Coriaria.**
15. **Canaga Odorata.**
16. **Clematis Flammula (Virgin's Bower).**
17. **Combretum.**
18. **Covellia Rhizocarpa.**
19. **Echites Caryophillata.**
20. **Euphorbia Jacquiniflora.**
21. **Ficus Elastica (India Rubber).**
22. **Franciscea Latifolia & Uniflora.**
23. **Galphimia Nitida.**
24. **Guava, Cattley's.**

25. **Ginoria.**
26. **Haptage Madhablota.**
27. **Hamiltonia (Suitable for Winter Layering)**
28. **Hibiscus.**
29. **Impomoea.**
30. **Jasmine Japanese.**
31. **Indian Jooee.**
32. **Juniperus Chinensis (Suitable, for Winter Layering).**
33. **Lagerstromia Flos Reginea (Jarul).**
34. **Lemonia Spectabilis.**
35. **Myrtle English.**
36. **Pear (Nashpati).**
37. **Magnolia Mutabilis.**
38. **Nerium (Valuable sorts like White Double, Kokilakhsa &c).**
39. **Ochna Squarrosa (Ramdhone Champa)**
40. **Olea Fragrance.**
41. **Parsonia Corymbosa.**
42. **Passiflora (Valuable Sorts).**
43. **Petroea Volubilis.**
44. **Piper Nigrum (Golmarich).**
45. **Plumbago, Blue (Suitable for Winter Layering).**
46. **Poevria Coccinea.**
47. **Pomegranate (Double Flowering).**

48. **Roupelia Grata.**
49. **Rhyncospermum Jasminides (Syama Lata).**
50. **Sapindus Emarginatus.**
51. **Seb or Sao.**
52. **Solanum.**
53. **Spathodia.**
54. **Stephanotis Floribunda.**
55. **Tecoma Stans.**
56. **Thunbergia Grandiflora.**
57. **Uveria Odorata.**
58. **Tristania Nerifolia.**
59. **Wisteria Chinensis.**
60. **Verbena (Both scented & flowering).**
61. **Weeping Willow (Suitable for winter Layering).**

GOOTEE OR BALL-GRAFTING.

By "Gootee" or "Ball-Grafting" is meant the mode of propagating a plant by taking off a small ring of bark in a firm healthy branch of the mother tree, just below one of the knots (leaf-buds) to a distance of an inch and a half, and then well scraping the inner woody parts, after which the portion is covered with a ball of clay **mixed with some suitable manure** in due proportions, and then bound securely and tightly in a cushion of cocoanut fibres by means of strong cocoanut threads, the covered portions taking roots in the course of a month or two during rainy season. In Bengal, excepting Mangoes and Sapotas (which are propagated by inarching), most of the Fruit Trees and Miscellaneous Plants and Shrubs are always multiplied by Gootee during rains.

SOIL FOR A GOOTEE.

The most essential thing for a Gootee is the preparation of a well manured earth which will facilitate rootgrowth in as quickest a time as possible. Formerly, rotten fishes were used, and these were mixed up with earth and applied to the operated parts of the twig. But, as the smell of rotten fishes is most offensive and harmful to human life, it can never be used (and is now seldom used) in a domestic garden. *Fresh and pure* Mustard Cake (called in Bengali *Sarisha Khoil*) which can be obtained either from a native Ghanee, or from an Oil-Mill, is now universally used in a Nursery Garden for the propagation of plants by Gootee or Ball-Grafting. The Mustard Cake should be as *pure and fresh* as possible, and hence it is better to procure it from a *Ghanee* where pure Mustard Oil is available.

Having procured a quantity of pure and fresh Mustard Cake from a Ghanee or Oil-Mill, you are to weigh out a quantity, say $\frac{3}{4}$th of a Seer, aud mix the same with 2 Seers of water. Let it dissolve in a suitable vessel for a period of 24 hours. After waiting for this period, weigh out 20 Seers (i. e. half a maund) of an ordinary dry garden-soil, and the dissolved Mustard Cake is then to be thoroughly mixed up with this soil, adding a little more water, if necessary, to work it into small clay-balls, which should neither be too much brittle nor too much sticky. This half Maund of ordinary garden soil, mixed with $\frac{3}{4}$th Seer of mustard Cake will yield just 100 clay-balls for ordinary fruit-grafts. Each of these clay-balls may be immediately applied to the operated parts of the twig, placing it in a cushion of cocoanut fibres and securely bound with cocoanut threads, in the manner described hereafter. If you cannot utilize all the clay-balls thus prepared in one day, you may use them for the next 2 or 3 days more, but retaining them longer would not facilitate a quick growth of roots, and in some cases, will not encourage growth of any roots at all.

The above proportion (20 seers of ordinary earth mixed with ¾th seer of pure and fresh Mustard Cake) is suitable for almost all Fruit Trees like Leechee, Guava, Star-Apple, Rose-Apple, Pumelo, Lime & Lemon, Orange, Fig, &c., and all other plants like Brunsfelsia, Hibiscus, Oleander, Franciscea, Bougainvillea &c. But there are a few delicate plants which cannot bear too much manuring, e. g. Magnolia, Croton or Dracaena, and the proportion of Mustard Cake in such plants is to be diminished (from ¾th Seer) to 3/8th Seer for every 20-Seers of ordinany soil used. That is, in case of such delicate plants, you are to take 1½powah or 6 chittaks of Mustard Cake mixed with 20 Seers of ordinary earth, and use it for Gootee purposes.

FURTHER PARTICULARS FOR A GOOTEE.

Having prepared your soil for the Gootee, you are to select only healthy and ripened twigs of the mother tree, rejecting weak and old branches. Too much old or ripened branches are useless for Ball-Grafting, as roots of such can never grow easily, and even if they do grow, the newly rooted plants can seldom survive. It is also important to note that your selected twigs are never more than the thickness of your middle finger, as bigger and more matured branches can never admit of an easy striking in a Gootee.

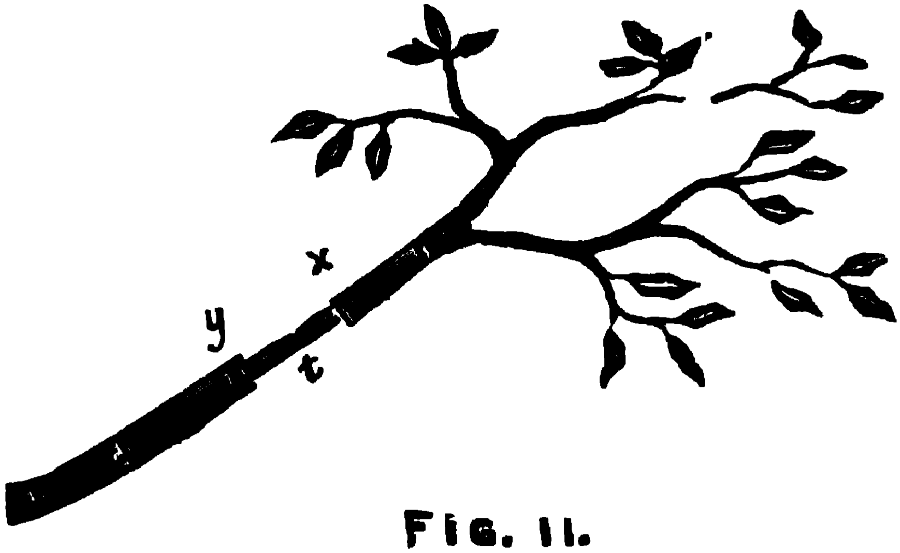


FIG. II.

The twig thus selected, is to be cut just below the knot (leaf-bud) *x*, (Fig. II.) depriving the outer skin or bark, but retainig the inner wood *t*, which should then be well scraped with the knife. (This scaping should be made (but not too violently especially in case of delicate plants like magnolias, crotons &c). The operation should be extended lengthwise all around to a distance of 1½ inch below, *i. e.*, generally from one knot to another, if the distance between the two knots be neither too much greater nor too much smaller. The manured clay prepared for the purpose, in the manner described above, is then put in a cushion of Cocoanut fibres (Fig. 12) and then applied to the operated parts, so as to cover these parts entirely, taking care to include a little more space (say an inch) above the upper knot. The object of this is to prevent the newly grown roots near upper knot from protruding out and protecting them from extremes of heat and dryness, without which they would grow and again perish. A little more covering may be unnecessary but never harmful.

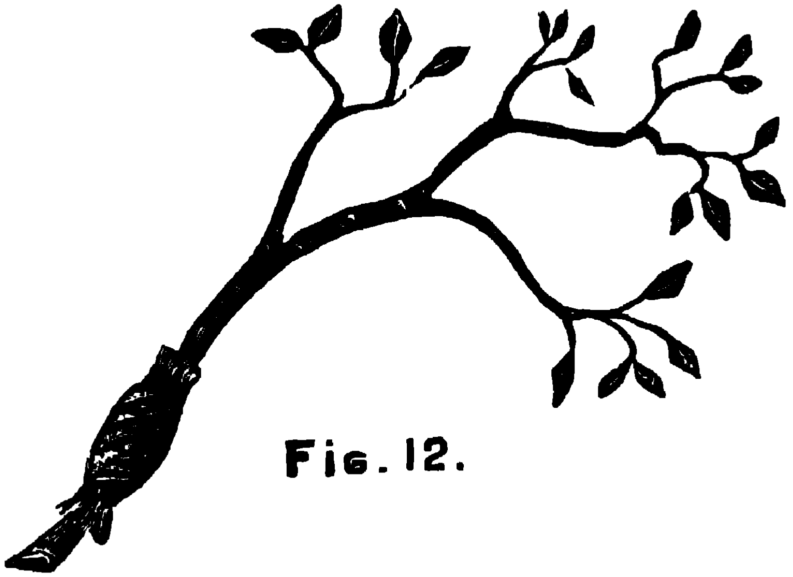


FIG. 12.

In a Nursery Garden, the propagator usually carries a small basket with him, in which he generally puts some 25 clay-balls at a time, and carries with him also a quantity of scraped Cocoanut fibres also put in the same basket and 25 Cocoanut threads cut to proper lengths for the purpose. Then he climbs up the mother tree, suspending the basket with the Cocoanut fibres in one of the branches, while the quantity of the Cocoanut threads is bound in his waist. He carries with him also the knife, selects his branches and operates on them in the manner just described. When he has finished the number, he does not come down from the tree, but asks his assistant for a fresh supply. Thus an expert workman, in the course of a day can make 160 to 200 Gootees without being fatigued.

SUITABLE TIME FOR A GOOTEE.

It has been already stated that Gootees or Ball-Graftings are always made in a Rainy Season. They may be attempted at any other time of the year, but then the propagator must have recourse to some artificial arrangements for keeping the Gootees continually moist. Obviously, this is not practical with any professional gardner, who desires to multiply his plants in quantities, *i. e.* by thousands.

An amateur, whose province is generally limited to a very small number of plants, may try such untimely propagation, when he wants to multiply a few plants of any particular specimen which may have taken his fancy, or when he is necessitated to have a duplicate plant in a fixed limited period of time, and waiting for the rains would be too late for him.

In such cases of emergency, the gardner should procure a small earthen vessel v (Fig. 13), which should be

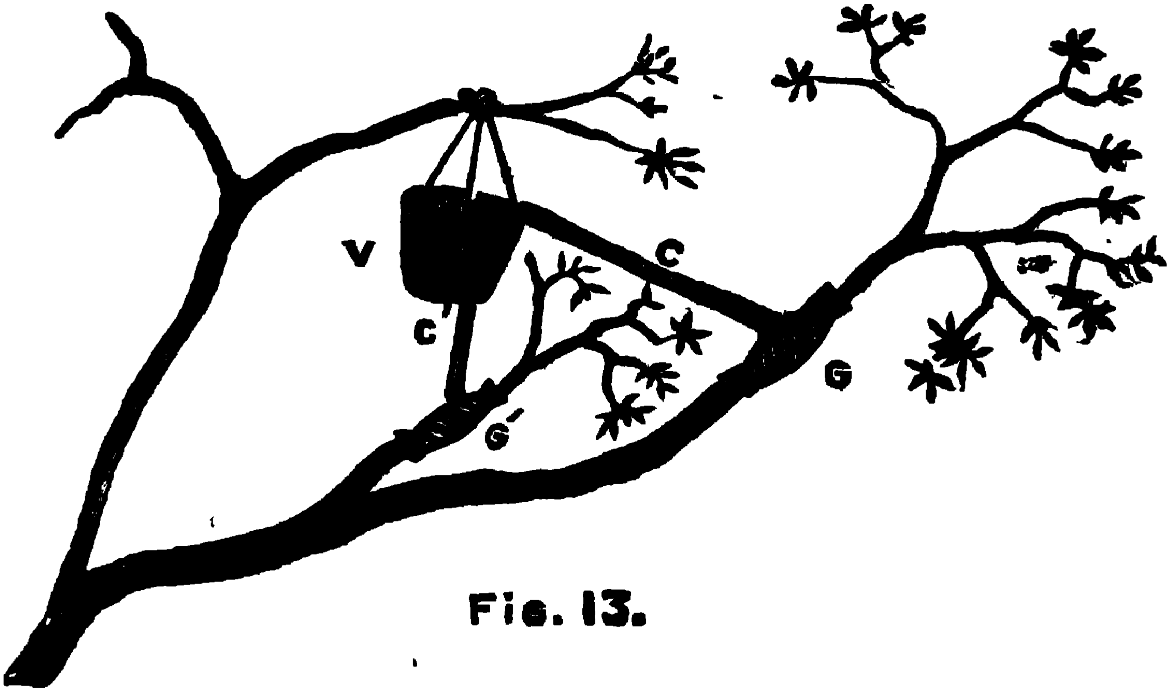


Fig. 13.

filled with water and suspended from a higher branch of the mother tree, as shown in Fig. 13. Stripes of cloth *c* and *c*' are inserted down this vessel, and made to communicate with any desired number of Gootees, as for example, *g* and *g*', levels of which must be lower than that of the vessel filled with water. It is better that the Gootees should be wrapped in a quantity of moss, so that the water from the vessel v, passing through the pieces of cloth by *capillary action* would keep the moss and the clay balls inside continually moist. The vessel should be refilled with water every day, and roots will grow inside the Gootees as quickly as in a Rainy Season. This artificial watering is sometimes resorted to in a Nursery Garden, especially in case of valuable plants like Amherstias, Magnolias &c.

MISCELLANEOUS HINTS ON A GOOTEE.

From my own personal experience as a practical gardener in close connection with practical workmen, I have found that most of the Fruit Trees, Flowering Shrubs and other plants generally take root by a Gootee in less than two months' time, and they can be severed from the mother in 10 weeks. I cannot agree with Mr. Masters, formerly Head Gardener in Calcutta Botanical Gardens that "Leechees require four months to form good roots", as I have propagated these mostly in 2 months' time, and have sold them in three months without any complaints from customers. Guavas and Star-Apples have struck in 15 days, although I have not removed them from their mother, until full period of one month has elapsed. I am sorry thut some of the most eminent authorities in Gardening like Dr. Roxburgh, Loudon, Gleenny, Sir John Paxton or Dr. Voigt, give incorrect times for the propagation of plants by various methods, and have even suggested in some cases rather impractical modes and principles of propagation, which are seldom practised and followed in a Nursery Garden, especially in India and the East.

When roots have sufficiently grown in your Gootee, which will be evident when they are seen protruding themselves from the bandage, the branch may be cut off from the mother. It is not at all necessary that the cutting should be made progressively. They should be cut off bodily *at once, not by instalments*, selecting a cool rainy day if possible. After cutting them off from the parent, soak them in water for 4 or 6 hours, or better, for a day in a cool shady place. Then carefully remove the Cocoanut threads with bandage of Cocoanut fibres, retaining only the clay ball. Put them in a bed previously prepared for them in a cool shady place. If no such site be available, then protect your beds by erecting some artificial shadings. The bed should be sufficiently high to ensure an easy and efficient drainage, and no chance of water accumulating. Protect these newly rooted plants from direct sunlight for a fortnight, by some suitable side and top coverings, e. g., leaves of Cocoanut trees or any such things, as may be available in the parts of the country in which you live. They are to be watered regularly, and the artificial shadings may be withdrawn and removed gradually when they are seen to put forth new leaves.

It is a general fact that most of the leaves of a newly cut Gootee, will fall off in a week's time after their separation from the parent. The dried up leaves are to be removed carefully from the bed together with any withered stems if any, and the bed of the newly rooted plants should be kept as clean as possible. The soil is to be stirred up once every fortnight to allow the young roots to develop and grow stronger. The bed is to be watered regularly, i. e., as often as it is dry, but never too frequently, otherwise the roots will "take cold" and perish. It is unavoidable that there must be a certain percentage of loss, but the number may be minimised if the above instructions are noted and followed carefully.

In the following pages will be found a List of Plants generally propagated by Gootee or Ball-Grafting.

LIST OF PLANTS PROPAGATED BY GOOTEE OR BALL-GRAFTING.

1. **Aeschyanthus.**
2. **Agati Grandiflora (Bak).**
3. **Aloocha.**
4. **Aloobokhara, or Aroobokhara.**
5. **Amherstia Nobilis.**
6. **Astrapaea Wallichii.**
7. **Averhoea Billimbi.**
8. **Avocado Pear (Aliget).**
9. **Banisteria Laurifolia.**
10. **Beaumontia Grandiflora.**
11. **Bougainvillea.**
12. **Bouvardia.**
13. **Bread Fruit.**
14. **Brownia Coccinea.**
15. **Brunsfelsia.**
16. **Calicarpa Arborea.**
17. **Camellia Japonica.**
18. **Catesbaea.**
19. **Cerbera.**
20. **Chimonanthus Fragrance.**
21. **Congea Azurea.**
22. **Crescentia Cujete.**
23. **Crotons (Only valuable sorts).**
24. **Cryptostegia Grandiflora (Chabuk Chari).**

25. **Cyrtanthera.**
26. **Dracaena (Only valuable Sorts)**
27. **Elephant Apple.**
28. **Eugenia Jambos.**
29. **Erythrina Blackii (Parijat).**
30. **Ficus Elastica (India Rubber).**
31. **Fig English.**
32. **Franciscea Latifolia.**
33. **Franciscea Uniflora.**
34. **Guava.**
35. **Gardenia Grandiflora.**
36. **Gardenia Lucida.**
37. **Gynura Aurantiaca.**
38. **Hamelia.**
39. **Hibiscus (Valuable Sorts).**
40. **Hoffmannia.**
41. **Jacquinia Russifolia.**
42. **Jatropha (Coral Plant).**
43. **Karamcha.**
44. **Knoxia.**
45. **Lagerstromia.**
46. **Lemonia.**
47. **Leechees.**
48. **Limes & Lemons.**
49. **Loquats.**
50. **Mackaya Bella.**
51. **Magnolia Fuscata.**

52. Magnolia Grandiflora.
53. Magnolia Pterocarpa.
54. Magnolia Pumila (Jahuri Champa)
55. Magnolia Mutabilis.
56. Mandevilla (Chilli Jasmine).
57. Mango (Dhar's Bomay and some other few sorts only).
58. Mangosteen.
59. Mulberry (Valuable Sorts).
60. Mussaenda.
61. Nepenthos (Pitcher Plant).
62. Nerium, or Oleander (Karubi, valuable sorts only).
63. Olive.
64. Olea Fragrance.
65. Oxyanthus.
66. Orange.
67. Ochna Squarrosa) Ramdhone Champa).
68. Paederia.
69. Pan Karpur.
70. Peaches.
71. Pentalinon (Savanna Flower).
72. Petroea Volubilis.
73. Plumeria.
74. Poivrea Coccinea.
75. Pomegranate.

76. **Polymnia.**
77. **Portlandia.**
78. **Pterospermum Acerifolium.**
79. **Pumelo.**
80. **Rondelatia.**
81. **Rhodostoma.**
82. **Roupellia Grata.**
83. **Rhappistemma.**
84. **Spathodia.**
85. **Swallow Wort.**
86. **Tecoma Stans.**
87. **Wrightia Anti-Dysenterica. (Koorchi).**

INARCHING.

Inarching is the process of artificially joining together by means of a thread the twig of a mother plant with that of a Seedling or rooted Cutting plant, by slitting them half and half and uniting exactly the slitted portions in order to facilitate a free course of the sap from one to the other. When the joined portions are thoroughly incorporated with each other, the twig of the mother is cut asunder from its original parent, receiving its supply of food and nourishment from the Seedling or the rooted Cutting.

The twig of the mother plant, i. e., the plant whose graft is desired to be made, is botanically termed the "*Scion*," and the rooted Cutting. or the Seedling plant which will supply food and nourishment to the desired plant is called the "*Stock*." Generally, the *Scion*, and the *Stock* are of the same botanical *genus*, but it is not absolutely necessary, as almost any Scion will take to any sort of stock provided there is a resemblance in their barks. In modern scientific ages, the curious Japs and the Chinese are very fond of making fantastic experiments in Grafting, and sometimes succeed in the most heterogeneous combinations, such as grafting Flower upon Fruit trees, or different Fruit trees upon one primary stock. I donot see any reasons why such fantastic experiments be not attempted with success in our favourable climates of India by every inquisitive Gardener, presenting such interesting new things to local Exhibitions for profit and pleasure.

In Bengal, two of the most important plants in a Nursery Garden, viz., the Rose (Queen of all the flowers) and the Mango (King of all the fruits) are always easily propagated by *Inarching*, and I hope, a full and detailed description for these will just suffice the requirements of a Gardener to understand clearly the principles of Inarching, in case of all small or big plants, proceeding like the one or the other as the case may be.

INARCHING OF ROSES & OTHER SMALL PLANTS.

Every Gardner in Bengal is acquainted with a wild briar Rose called *Gigantia*, whose Cuttings strike most readily almost in any soil and under any conditions immediately for several months just after the Rainy Seasons are over. This wild briar Rose is known among the native population as "Ella" or "Jayghanti," and this is universally used as the *stock plant* in Bengal for any desired Rose to inarch upon, excepting the Sweet Briar Rose which is inarched upon either Rosa Indica or the Do-Runga (Arch Duke Charles).

In Bengal, immediately as the Rains are over, every professional Gardener will be found to be busy with raising rooted Cuttings of Gigantia. He selects a high soil, so that there may be no accumulation of water in its surface, pulverizes the soil, exposes it for a day or two in the sun, and when dry, he turns it into a fine loose bed and inserts his Cuttings of Gigantia, each six to eight inches long. Too much slender Cuttings would be useless, as possibly they cannot be a match for the *Scion*, i. e. the branch of the mother whose graft you are going to make should be roughly of the same thickness as the Gigantia. Slender cuttings are useful only in case of some very fine and small Tea Roses, whose branches are themselves very thin and slender. Generally, Cuttings of the thickness of a lead pencil (be it a little over or under) are selected and made, as these are found to match very well with the Scion. The bed is regularly watered every day, and in about three weeks, the Cuttings will form roots, when they are transplanted with small suitable clayballs at their bottom in a temporary bed, called *Hapur* by native Nurserymen in Calcutta. By such transplantation, they must necessarily undergo a partial damage, but excepting a very few, most of them will recover in a week or ten days. When they have fully recovered from such effects of transplantation and are showing signs of fresh growth, they may be at once utilised for Inarching purposes in the manner noted below.

The Gigantias, when they have fully recovered from effects of transplantation, are brought near the mother Roses, and are put in the ground either inclined or vertical, just to see that that they may be made to touch each other without much difficulty. A branch of the mother is first brought down by means af the pin *p*, (Fig. 14). and the Gigantia is then put in the ground close near it as at G, the bed for the mother plant being previously stirred up to make it sufficiently loose to allow both the stock and the scion

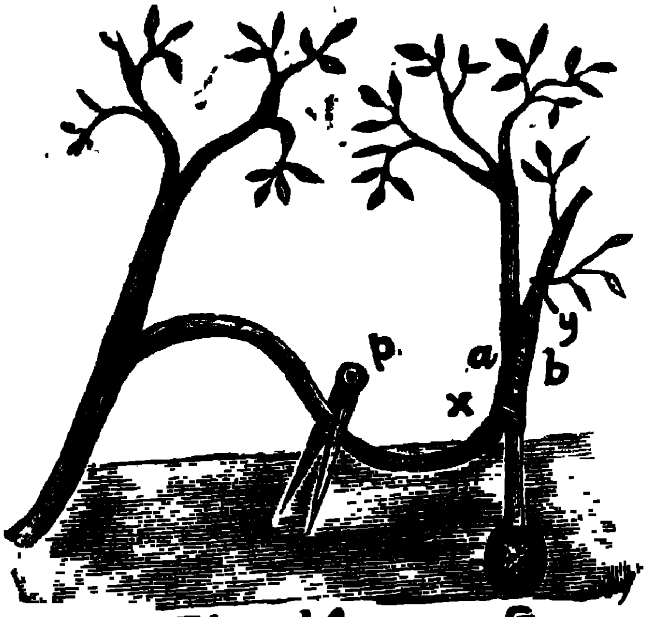


Fig. 14.

to grow vigorously. The branch of the mother and the parts of the stock where they touch each other are then slit half and half generally to a length of an inch and a half, as shown in Fig. 15 (*a* & *b*), taking care to slit in such a manner as to fit exactly with each other. They are then united together at the cut portions by a suitable string (generally made in Bengal of raw jute fibres) and bound as tight and fast as possible as shown in Fig. 14, parts *a* & *b*. Both the mother and the Gigantia are then watered regularly until the Gigantia has grown vigorously with a good many number of new leaves or branches. In about a month's time you will notice that the thread at the slitted portions has sunk a little deep into the body both of the scion and the stock. This

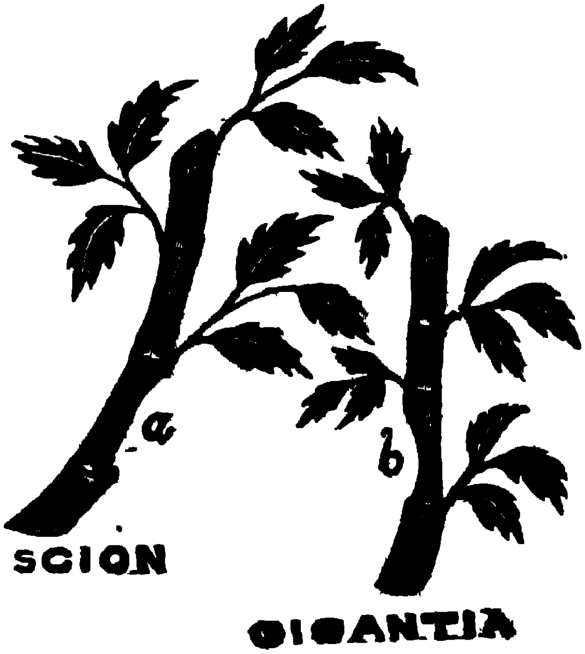


FIG. 15.

is a sign that there is a free circulation of the sap from stock to scion and that the scion can now depend for its supply of food on the stock, without receiving its supply of nourishment from its original parent. At this time you will also notice that the line of demarkation between the stock and the scion at the united parts near their barks is so close that their union may be considered as perfect and the scion may now be dissevered from the parent without any risk of losing the newly grafted plant.

When the union between the stock and the scion is complete (which generally takes place from 4 to 6 weeks, or rather from 6 to 8 weeks to ensure a *pucca* union), the scion is dissevered from the mother by cutting it at the point x. (Fig. 14). i. e. immediately below the joined portions. The Gigantia is also headed down at the point y (Fig. 14). i. e. immediately above the united portions. The newly grafted plant is then carefully removed from the ground and put in a cool shady place, when it is sprinkled with water from time to time, and allowed night dews by placing it outside in open air at night. It is advisable to dissever a newly grafted Rose in cool hours of afternoon, so that it may have the advantage of night dews immediately after the scion is deprived of its supply of food from the parent. After nursing the plant in this way for two or three days, it may be put down either in a pot or in a suitable bed prepared for the purpose in a sunny situation.

A grafted Rose should be put in ground or in pot in such a way as the *whole* of the grafted portion is put *inside* the ground. The object of this is to prevent the wild briar Rose (the stock) from enforcing its growth and sending out its own shoots and branches from below the joint, i. e. from the body of the wild Rose itself, which should be destroyed immediately as they appear, otherwise the scion (the desired Rose) may perish.

A newly grafted Rose may shed down its original leaves after its separation from the parent in a week, but this is no reason that the plant will not survive unless the branch of the scion shrivels up bodily, but even then it is not prudent to give up all hopes for the new plant, for I have found instances of revival even after a complete bodily shrivelling up of the scion in its branch.

Sweet Briar Roses are inarched exactly in the same way as all other Roses, the difference being in use of the *stock* which is selected instead of Gigantia, either the Rosa Indica or the Do-Runga. It has been practically found that if grafted upon Gigantia Stock, the plant cannot survive long, probably through an inadequate supply of food by Gigantias.

What has been described about Roses, may apply with slight modifications, in case of Inarching of all smaller plants, whose parents can be brought down to the ground with pegs, selecting only the appropriate *stocks* to inarch upon.

INARCHING OF MANGO TREES.

Mangoes and other big trees whose branches cannot be made to touch the ground with pins or pegs as described above, are inarched by first erecting a strong bamboo scaffolding at a suitable height so as to have a free and an easy access of most of the scions intended to be grafted. The scaffolding is converted into a platform by means of half-slit bamboos, put longitudinally on its top close to each other, and upon this platform are put a number of pots, containing the seedling mango plants, each pot carrying two, three or more seedlings according to its dimensions. Then the scions intended to be grafted are brought close to stocks by tightening the scion with the platform at suitable intervals, and then using pins on the pot if necessary. The seedling mango should be roughly of the same thickness as the twig of the mother, and hence it is necessary to use discretion in previously selecting the seedling mangoes, which should be roughly of the same thickness as the scion. The stock and the scion are then first temporarily fastened without slitting at the proposed joined portions (generally by plantain fibres in Bengal). The object of this is to allow both the stock and the scion gradually

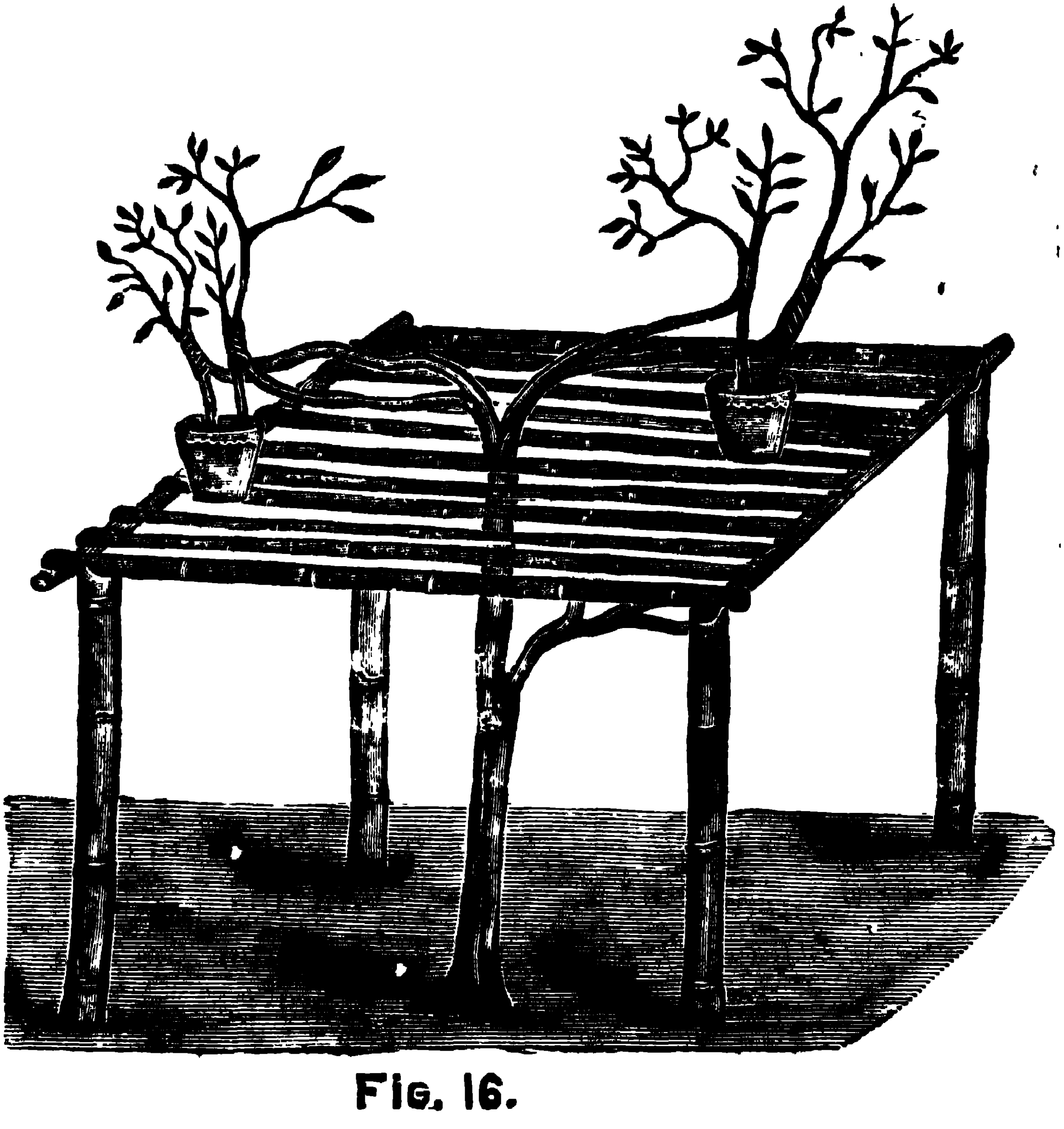


FIG. 16.

accustom to this position for three or four days or better for a week, so that there might be no fear of breaking at the time of slitting. After this, the parts coming in contact with each other are slit half and half, exactly in the same manner as Roses are grafted, and immediately tightened as fastly and securely as possible by means of strong jute fibres. If it be not a Rainy season, the pots are watered at regular intervals to allow both the scion and the stock to grow vigorously. While watering the pots on the scaffolding, care should be taken that this is done very gently i. e. without bodily disturbing the parent and the stock, especially at joined portions. In eight to ten weeks the graft is complete, which will be evidenced by the sinking of the thread into the body both of the scion and the stock, and then the scion may be dissevered from the parent. Fig. 16 gives an illustration showing how a scaffolding is made and pots placed upon it and the scions grafted with the stock.

FURTHER DETAILS FOR MAKING MANGO-GRAFTS.

Mangoes are generally grafted on 2 years' old seedlings, as they are considered to be the best and most appropriate stock to use. Bigger seedlings which are too much ripened, cannot take the scion freely and easily, and unless you have patience to wait for a full period of three months or more,there cannot be a free circulation of the sap from the stock to the scion, and possibly your grafted plants will not survive, if dissevered earlier. They generally make weak and bad grafts. For this reason, it is advisable to reject all too old and too ripened branches of the mother, using only healthy and partially ripened young twigs, which give quickest results and generally make best grafts.

The first important thing in Mango-Grafting is the propagation and maintenance of suitable Mango Seedlings for the purpose, which are the only stock plant used by every Nurseryman in India for making Mango-Grafts. When ripened fruits of Mangoes are daily being sold in the Bazaar at moderate prices, I presume every household in India, purchases some for the use of its family. An intelligent amateur should not throw away the seeds after the fruits being used by the family, but sow them in some suitable place of his garden to raise a number of seedlings which may be afterwards used and utilised in making a number of grafts of some of the best Mango trees in his own domestic garden. This will serve his double purpose, both profit and pleasure, but such an idea is surely impractical for a Nurseryman or a professional Gardener, whose sphere or business is far wider to admit of purchasing ripened fruits from the Bazaar, and utilising the seeds after their being used by the family. He would require seeds by thousands, and purchasing ripened fruits by thousands would be surely too much expensive and hence quite impractical.

Every professional Gardener or Nurseryman purchases every year seeds of Mangoes from the poorer class in the locality, who would generally collect the used fruits (i. e. seeds) thrown away by a household in the Streets of a Town. He generally sells them at an Anna for 100 Seeds in the Calcutta Market, delivery free at the address of the Gardener. Thus, if a Nurseryman in the town of Calcutta requires some 10,000 seedlings, he will have to invest Rs. 6/4 for the purpose. This method of procuring seeds of mangoes is undoubtedly the best and most economical.

But, as the collection of such seeds every year is sometimes uncertain, depending upon the whims of the poor, who would never care to procure these if they are otherwise profitably engaged, when they would naturally demand fancy prices, I have practically given up (at least for myself) this uncertain mode of procuring seeds, which I generally require 15,000 to 20,000 each year. I send four of my intelligent Sonthal Malies every year to Calcutta *Dhappa* lands, where all street sweepings for the town are deposited, sometime in the months of July or August who would collect for me in four or five days the required number of 20,000 seedlings every year. The consumption of Mangoes in an important town like

Calcutta is enormous, and the thrown away seeds going to *Dhappa* lands in Scavengers' Carts amount to lacs and millions, where they spontaneously germinate and grow without any care of human hands, owing to the great fertility of the loose soil there. These *Dhappa* lands belong to an *Ijaradar*, who issues a Pass to collect these Mango Seedlings, each bundle which can be carried by a man requiring a Pass of As. 8 only. I instruct my men to carry as much heavy and full bundle as possible, and a strong and intelligent man would carry almost a double load at least up to the gates and offices of the Ijaradar, when he would unpack the same, subdividing into two lighter bundles. In one full heavy bundle he would carry some 2000 Seedlings, costing him As. 8 only. Outside the precincts of the Offices and Gates, each man will carry a bundle of 1000 seedlings, which he easily brings to my Garden without being much fatigued Thus 20,000 ready-grown Seedlings cost me Rs. 5, *plus* the wages and extra allowances of the men which cost me a further sum of Rs. 12/- or so. Roughly speaking, for the sum of Rs. 20/-, I get annually 20,000 seedlings.

These ready made seedlings grown in *Dhappa* lands are not at all difficult to remove from the ground and collect, owing to the very loose soil of these lands, the plants yielding and coming up at the slightest pull. When the Seedlings reach my Gardens, their roots are partially cut off at the ends (technically called *dressed*), and put in a previously prepared ground in a high sunny situation at a distance of 9 inches apart. If there be no rains, they are regularly watered. About 25 % of the Seedlings fail to establish, but the rest grow, and at least 40 % of the remaining plants may be utilised for grafting purposes next season, and the remainder in the subsequent year.

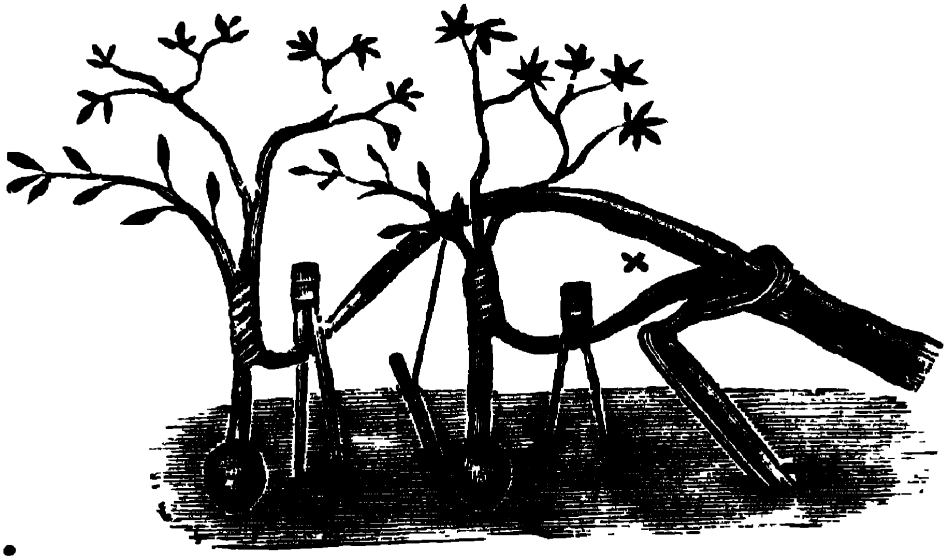
An amateur or a Gardener who has not the facility of utilising spontaneously grown seedlings in the locality, should proceed in the manner described below for raising his necessary seedlings for inarching purposes of his Mango Trees.

The Mango seeds are to be sown sometime in the month of July. An ordinary Garden soil previously made light and mellow, would suit them. The seeds are to be sown 2 inches apart, and covered up with earth half an inch at the top. They will germinate in 4 to 6 weeks, or earlier, if conditions are favourable. After two months they are to be transplanted, partially cutting their roots near the ends, by virtue of which the roots become hardier and grow more easily. Their bed should be a high one, and fully exposed to the sun, otherwise the seedlings will be weak and slender and can never be utilized for grafting purposes next year. About 40 % of the surviving seedlings after their transplantation, will be thick enough for grafting next season, and the remaining slender and weak ones which have not still grown upto desired thickness may be utilized for inarching purposes the next following season.

In Bengal, immediately as the monsoon sets in, the propagator transplants his Mango seedlings from their bed, selecting only those which have grown roughly to the same thickness as his fingers. He carefully removes these from the ground, retaining suitable clay-balls at bottom. These are then temporarily placed in a cool shady place for two or three days, after which they are put in *Hapurs* or temporary beds prepared for the purpose close to each other just as to give them every facility to recover from effects of transplantation. When they are found to have revived, they are put in pots, 2 or 3 in each, and these pots are carried up the scaffolding by means of a ladder and put near the mother plant and grafted in the manner described above. In a Rainy Season, these pots need not be watered, as they naturally remain damp by rain-water, every now and then. But, if you are late in making your Mango-Grafts, i. e., if you commence grafting in the month of September or October, the pots are to be watered every alternate day, or as often as you find them to be hard and stiff. An occasional stirring up of the soil in the pots is also beneficial, say once every two weeks. A Mango-Graft is generally ready for dissevering in two months, but waiting a little longer makes the graft a sure and *pucca* one.

In a Nursery Garden, as costs of erecting a scaffolding and i's necessary maintenance are too much heavy, sometimes the parent trees which are not too big, are artificially laid down to the ground by making an opening in the ground near its trunk on one side and forcing the same down by means of ropes and pins as shown in Figure 17. A majority of the branches are thus artificially made to come near the ground, which then may be grafted in the same way as Rose-Grafts. But in such a case, the mother plant must necessarily suffer to a great extent, some of its roots being necessarily destroyed. In laying

FIG. 17.



down a mother tree, it is important to note that the main primary roots of the mother are not interfered with in any way, as then it will most likely perish before being utilised for grafting purposes. I should never suggest that a valuable mother in a Garden should be damaged or destroyed in this way.

When a thorough union of the barks between the stock and the scion has taken place, which will be evidenced by the thread having sunk a little deep in the joined parts, and the line of demarkation between the stock and the scion near their barks almost disappearing, the scion, i. e. the twig of the mother is first cut near the lower part of the union, and the pots on the scaffolding are then removed and placed in a cool shady place, where they are watered daily, allowing night dews by putting them outside in open air. This is done for two or three days, after which the stock plant is headed down up to the upper part of the joined portions and are put in their permanent beds or sites, which should be high and sunny.

If you were to examine a newly grafted plant by Inarching system, you will see on dislocating the joined parts, that the scion and the stock are united with each other *in their barks only*, the inside woody parts have never united with each other, and no signs of circulation of sap in these parts, but only rendered brown and slippery both in the stock and the scion. This union of woods takes place only when the graft has attained three or four years in case of Mango-Grafts, and full one year in case of Rose-Grafts.

INARCHING OF MISCELLANEOUS PLANTS.

All plants are inarched like Mangoes or Roses, taking care to select their proper *stocks*, which will take the scion readily in its body, i. e. whose barks will readily unite with each other. Thus the *Stock* plant for Sapota is *Khirnee* (Mumusops Kauki); that for Larus Cassia (Tej Patra) or Cinnamomum Zelanicum (Daruchini) is Piper Cubeba (Cababchini); while Magnolia Mutabilis and White China Champa are always grafted on the Stock plant Swarna Champa (Mitchellia Champaka). It will, therefore, be seen that every *Scion* has a suitable *Stock* plant to inarch upon.

In the following page, I give a List of Plants which are multiplied by Inarching, giving also the names of the *Stocks* on which they are usually grafted.

LIST OF PLANTS INARCHED UPON.

	Name of the plant grafted. **(SCION)**	*Name of the plant on which grafted.* **(STOCK)**
1.	Anona Muricata	Seedling plant for same.
2.	Anona Reticulata	Seedling plant for same.
3.	Anona Squamosa	Seedling plant for same.
4.	Assafoetida Multani (Hing)	Gardenia Grandiflora.
5.	Cinnamomum Zelanicum (Daruchini)	Piper Cubeba.
6.	Crotons (Valuable Sorts)	Crotons (Ordinary Sorts)
7.	Jack Fruit	Seedlings for same.
8.	Kamranga China	Kamranga, Country.
9.	Larus Cassia (Tej Patra)	Piper Cubeba (Kababchini).
10.	Loquat.	Seedlings for same.
11.	Mango	Seedlings for same.
12.	Magnolia Mutabilis	Swarna Champa (Mitchellia Champaka
13.	Mitchellia China White	do. do.
14.	Orange	Lime or Orange Seedlings.
15.	Peach.	Seedlings for same.
16.	Roses excepting Sweet Briar.	Gigantia.
17.	Sweet Briar	Rosa Indica or Do-Runga.
18.	Sapota	Khirnee (Mumusops Kauki).

BUDDING.

Budding may be defined as taking *bodily* a small bit of the mother plant and inserting it on the stock plant under suitable conditions, when the small bit of the scion (i. e. the mother which you desire to multiply) is thoroughly united in course of time, with the stock plant which is evident when leaves and branches are seen to grow from this detached portion of the mother after union, the stock plant being deprived of its own growth by cutting down its own leaves and branches, retaining only those of the united scion. Thus, it will be observed that there is a marked difference between the two processes, Budding & Inarching ; in the case of a *Budding*, the scion is deprived of its supply of food *the moment it is* grafted, whereas in the case of *Inarching*, it continues to receive its subsistence from its own mother until the grafted portions are thoroughly united with each other and then it is dissevered from its parent.

Budding is of four kinds (1) Budding Proper or Side Budding ; (2) Tube Budding ; (3) Wedge Budding ; (4) Cleft Budding. Every one of these methods is explained and described below.

The operation of Budding is performed with great facility and success in the Upper Provinces, but it is seldom attained with success in the vicinity of Calcutta and generally in Bengal (I am sure owing to climatic influences), and hence with the exception of Plums (Zizyphus Jujuba) it is rarely or never attempted here in Bengal, Inarching being uniformly adopted instead.

BUDDING PROPER OR SIDE BUDDING.

Budding Proper or Side Budding is the commonest mode of Budding. It is performed when the leaves of plants have grown to their full size, and the leaf-bud is to be seen at the base of it. The relative nature of the bud and the stock is the same as in Inarching. First select your stock plant. Make a slit, say an inch or more according to the size of the plant, just commencing from one of its knots and extending down below. Make another cross slit near the knot, and take away the outer bark of the stock in a triangular form, as shown in Fig. 18. *a.* Then take an equally triangular slice of the bark from the tree or plant whose budding you desire to make. You must select this slice from the desired mother and see that it is cut just above one of its fully grown knots (leaf-buds), and extended in a triangular form to reach 1 inch to 1½ inch below this knot. In taking away this slice from the parent, if you have removed a small bit of the innner wood along with bark, you are to take away this wood carefully with the sharp point of your pen-knife and your thumb. See that the operated parts of the stock (Fig. 18 *a*) fit exactly with the dimensions of your bud, *b*. Then bind the bud *tightly* with the stock (not loosely as suggested by some authors) by a ball of cotton twist or stripes of plantain fibres, letting the bud come at the part where the slits cross each other (as shown in Fig. 18 *c*). The newly inserted bud is then covered with some moss and watered daily. No part of the stock should

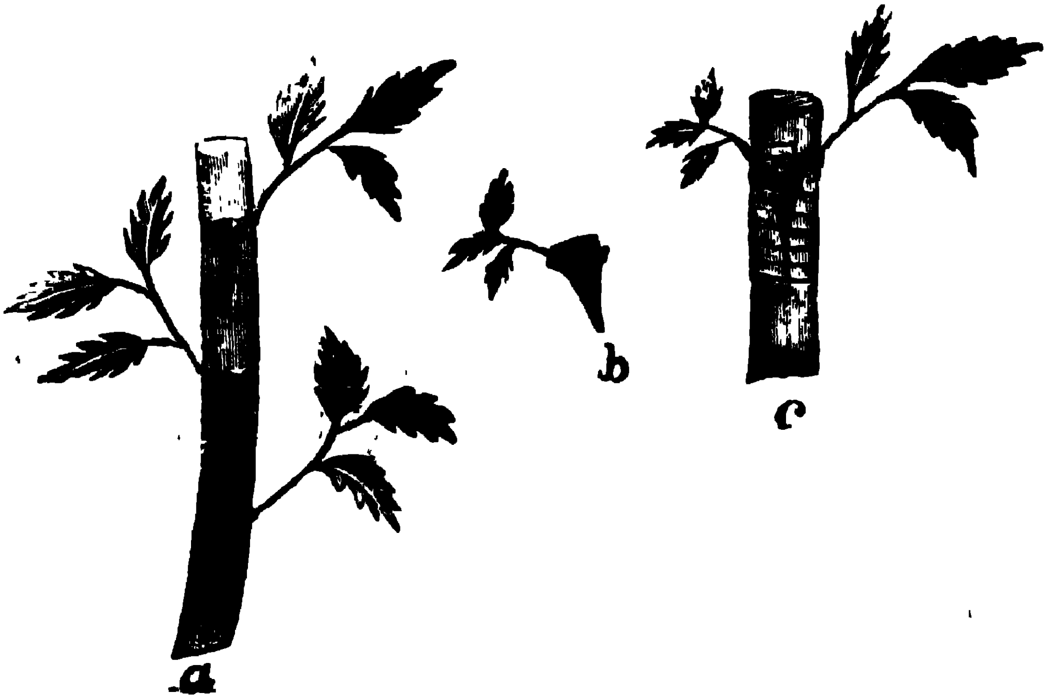


Fig. 18.

be allowed to grow after it is budded, except one or two little shoots or so above the bud, just to draw the sap past the bud.

The time when the operation of Budding can be performed with success, depends upon the fit conditions of the plants used to be budded upon. If by cutting through the bark down upon the wood, you see that your pen-knife can be thrust freely between the bark and the wood, you may be assured that the budding can be successfully attempted. On the contrary, if the bark adheres firmly, and it is difficult to separate it from the wood, it is of no use to attempt budding at that time. Thus the operation of Budding can be safely commenced upon, only when the bark is found susceptible of removal without any difficulty.

Budded plants are for some time very liable to be damaged at the point where the bud has been inserted by careless handling, or strong winds or other causes. To guard against such accidental damages, it is advisable to protect them by means of suitable stakes prepared for the purpose and driven in the ground.

TUBE BUDDING.

In Bengal and near about places, Tube-Budding is practised with much advantage in grafting of finest plums (Zizyphus Jujuba). The operation is very simple and easy to perform, and universally adopted here for propagation of this important fruit found so often both in European and Native Gardens.

In Bengal, and in most parts of the plains of India, a wild variety of common plum (called Topah Kool in Bengali) is met with in great abundance. They grow very rapidly without requiring any systematic culture or attention. One year old seedlings of such jungle plums are selected as the stock plant for budding of the three finest varieties of Jujuba, viz., Narikeli, Benares and Bombay. A young and healthy stem of the wild plum is selected for the purpose. It is first headed down at the point

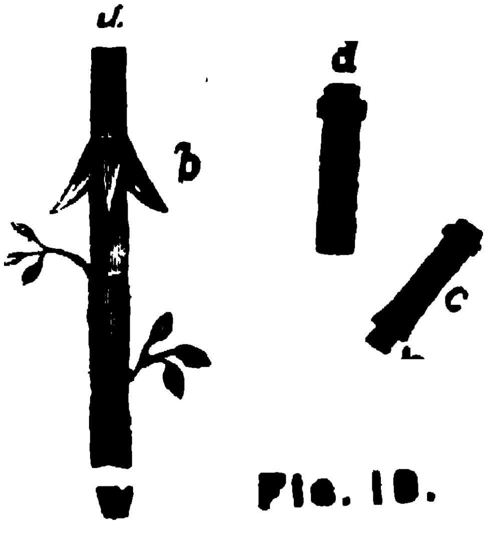


FIG. 18.

a, immediately under a joint (Fig. 19). A ring of outer bark is then taken away upto the knot *b*. It is not necessary to take away and remove this outer bark bodily from the wild plum,-let it be allowed to remain below the knot *b*. Then you take a small cut twig of the plum you desire to graft, which should be of the same dimensions as the parts from *a* to *b* of the wild plum *w*, before the outer skin was drawn out (Fig. 19). This cut twig must have a knot at its upper extremity and without any such at its lower extremity. At this lower end, a very small ring of bark is taken away all round, so as just to allow the inner wood to be exposed at the point *x*, which is then held firmly by your teeth and pulled, when the inner wood comes out very easily (this being a special characteristic of all plums), and this inner wood is then thrown away. In this way you get a hollow cut twig of the parent as at *d* of Fig. 19, and this hollow part is put as a cap from *a* to *b* of .the wild plum, w. Care should be taken to see that *d* exactly fits the parts from *a* to *b*, and its upper knot just touches the point *a*. It is not at all necessary to bind this portion with cotton twists or any other suitable threads as in the case of Side Budding. In a couple of days you will find that the cut twig of the desired Jujuba has fitted so firmly in the wild plum, that you will not be able to take it out again from the stock. This is due to the fact that a sticky efflorescens oozes spontaneously from the stock which binds the hollow scion tightly in its own body,-this being the nature of the Jujuba family, and hence the budding is attained with great success for such class of plants.

Tube Budding for Jujuba is practised in Bengal during Spring, or rather just before the hot season commences. In a fortnight the graft takes, as will be evident from fresh shoots and leaves growing from the detached skin of the parent fixed on the stock. Every other shoots or leaves growing from the body of the stock must be carefully removed. The newly grafted plants are transplanted in a cool day, generally just at the commencement of the Rainy Season.

The transplantation of Jujuba grafts requires some skill and careful handling, as all Jujubas have only a main primary root, which generally goes deep in to the soil. If this primary root is much damaged at the time of transplantation, your graft is not likely to survive. Hence in transplanting Jujuba Grafts, it is always abvisable to make a deeper hollow near its roots before attempting transplantaion, and then take out the clayball, retaining a more quantity of earth than what is required in case of other plants.

WEDGE BUDDING.

The operation of Wedge-Budding is best demonstrated in the grafting of Papayas in modern Scientific Ages. It is a mistake to grow Papayas from *Seed*, which is very usually the case with almost every garden in India. Papayas should be grafted, so that you may maintain one select standard and keep them pure. To obtain the scion (i. e. shoots for grafting), decapitate a tree in fruit. Three or four weeks later, a large number of shoots are produced in the mother plant whose graft you desire to make. When a few inches long and the diametre of a lead pencil, each is cut to a wedge point. The seedling Papaya is also headed down, and the Scion inserted in a cleft of the young seedling Papaya which has been cut down to six inches and split with a sharp knife. The stock is tied with a soft twine, and shaded for a few days. On the seventh day, the twine is removed.

In Florida in America, this system of grafting Papaya is universally adopted. Plants grafted in Spring come into bearing in November or December, and continues in the following Spring or Summer, and can be left to bear fruit in the following Autumn. The Papaya is a gross feeder, but indifferent to soil.

CLEFT BUDDING.

In a Cleft-Budding, the stock is generally twice or thrice as thick as the scion. Head down the stock to within nine inches to one foot of the soil. Then take a fine-toothed Tonon-Saw, and remove a part of the stock by means of this saw, and make a cleft in a wedge form as shewn at *x*, Fig. 20. Then prepare the scion as shown at *b*, also in the shape of a wedge, with its shape and dimensions just to fit in *x* of the stock. After this, you are to insert the scion *b*

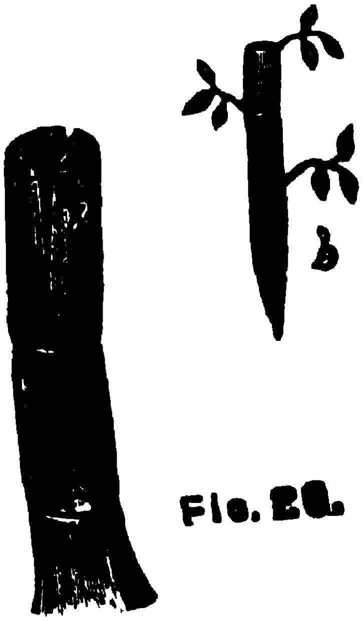


FIG. 20.

in the stock *x*. It is important to note that their barks at the cut portions should touch each other. Bind the stock and the scion by means of a suitable thread and wrapping them with damp moss, which should be watered from time to time to keep the parts continually moist. This method of Budding is generally adopted when you desire to utilise an existing old mother in your garden, which has turned out valueless as regards quality and quantity of fruit-bearing, by grafting upon it a valuable species of the same genus.

All plants which can be propagated by Inarching. can also be propagated by Budding.

SEPARATION BY DIVISION.

Separation by Division consists in multiplying plants by separating the numerous rooted stems of the mother plant growing in clumps, or in the case of Tuberous and Bulbous plants, by separating the bulbs or tubers either bodily or by cutting one and the same tuber into several parts. Thus there are three kinds of Separation by Division—(1) Separation of rooted stems; (2) Separation of Bulbs or Tubers (3) Cutting of the individual Tuber into several parts, retaining an eye in each of these parts, from which new plants would grow.

SEPARATION OF ROOTED STEMS.

Plants like Chrysanthemums, Heliconias, Plantains &c., are always propagated by separation of rooted stems. Excepting the hottest parts of the year, the process of separation may be successfully attempted, either in Rainy Seasson or during Winter months. Remove the earth near the roots of the mother, and tear asunder each separate rooted shoot or sucker. Prepare a piece of ground in a shady spot by digging it up, and rendering it mellow with a mixture of old manure and a little sand. Put down the shoots and suckers in manner of Cuttings in rows a foot apart, and a foot between each shoot in the row. Water them daily, and they will soon establish themselves and grow with great vigour.

Ferns may be easily propagated in this way during Rains. Turn the mother out of its pot, remove whole of the earth from its roots, and then pull it completely to pieces by tearing apart each separate shoot or sucker with some roots adhering to it. Put these young plants into small pots filled with broken pieces of bricks, Jhama, or such like things mixed with earth, care being taken that the pots have an efficient means of drainage and no chance of water-clogging, either in the body of the pot itself or just under their bottom where they are put. While preparing pots, ask your potter to make the bottom hole just near the bottom at one of its sides instead of making the hole exactly at the bottom, the object being to prevent earth-worms entering the pot from the bottom touching the soil. In a short time the newly separated Ferns will establish themselves as new independent plants.

All Terrestrial Orchids (i. e. Orchids cultivated in grounds) may be easily propagated like Ferns. Celestial Orchids (i. e. those which are cultured on pieces of wood, or on the trunks and branches of trees with moss and cocoanut fibre may be separated likewise just as Ferns, and then bound in moss and cocoanut fibre with cocoanut threads either on suitable dry pieces of wood or tied on trunks or branches of trees. They should be always put in an airy shady place (as also Ferns), and watered regularly to keep them healthy and green.

All plants of the type, Ananas Sativa, are propagated most readily during Rains by striking their "Crowns" or side suckers (without roots) from their fruits in an ordinary soil, better mixed with some sand in a shady place. Do not throw away the stump of a Pine-Apple, but place it in a damp pit, when latent eyes will spring forth, and you will get a crop of new plants.

The following is a list of plants propagated by separation of stems (mostly rooted) :—

LIST OF PLANTS PROPAGATED BY SEPARATION OF STEMS.

1. **Acanthus.**
2. **Aloe.**
3. **Ananas Sativa.**
4. **Ananas Striatifolia.**
5. **Anemon.**

6. **Arum Lily.**
7. **Agave.**
8. **Bambosa.**
9. **Begonia.**
10. **Bilbergia.**
11. **Bhui Champa (Kaempfieria Rotunda)**
12. **Carludovica (Fan Palm)**
13. **Chamaclaedon.**
14. **China Grass.**
15. **Chrysanthemum.**
16. **Cyperus.**
17. **Episcia.**
18. **Elephant Grass.**
19. **Elletaria Cardamomum (Big & Small).**
20. **Ferns.**
21. **Gesnera.**
22. **Hedychium.**
23. **Heliconia.**
24. **Hydrangea.**
25. **Iris.**
26. **Lemon Grass.**
27. **Maranta.**
28. **Musa (All sorts of plantain species).**
29. **Nandina (Chinese sacred Bamboo)**
30. **Ophioxylon.**
31. **Orchids**
32. **Peperomia.**
33. **Pitcairnia.**

34. **Ribbon Grass,**
35. **Rudbeckia.**
36. **Violet.**
37. **Yacca (Adam's Needle).**

SEPARATION OF BULBS & TUBERS.

This is the easiest mode of propagating most of the bulbous plants. Only tear asunder the bulbs grown in clumps, and put them separately apart either in pots or in ground. Thus a number of plants will be multiplied according to the number of bulbs separated. Tuberoses, Amaryllis, Liliums, Narcissuses, Zephyranthes, Haemanthus, Hemerocallis &c. &c., are all very easily propagated in this way.

The propagation of Dahlias from Tubers requires some special care. The buds or eyes of Dahlias are not scattered all over the tuber like those of Potato, but collected in a ring round the bottom of the stem. In a dry state of the bulb, these eyes can hardly be perceptible, so that while taking up Dahlia tubers from the ground at the time of storing Dahlias for the next season after they have finished their growth for the year, great care is always necessary to see that in separating the individual tubers from the clump, the upper parts near the stems are never damaged. If this is done, no plants ean be obtained during next season when put in ground.

Separation of tubers should be done only when the plants have finished their growth for the season, which is the case when they have finished their flowering for the year. After this, to facilitate ripening of the tubers—to ensure their full maturity—discontinue watering for some days. This is absolutely necessary in storing tubers of all sorts of bulbous plants, which "rest" for some months every year, otherwise the immatured bulbs stored up, will decay and rot more quickly than thoroughly matured ones. When the stems of such plants decay, cut them down within an inch of the soil. Then take up the tubers carefully, and do not leave them exposed long to the outer air, or they will be apt to shrivel up and perish, but as soon as they are quite dry, they should be laid in a suitable wooden box or Gamla, and covered well over with a mixture of dried earth and sand, and stored away in a dry cool place till they are required for the next season.

LIST OF PLANTS PROPAGATED BY SEPARATION OF BULBS OR TUBERS.

1. **Achimens.**
2. **Amaryllis.**
3. **Caladiums.**
4. **Crocus.**

5. **Crytanthus.**
6. **Dahlia.**
7. **Eucharis Amazonica.**
8. **Eurycles.**
9. **Funkia.**
10. **Giadiolus.**
11. **Haemanthus.**
12. **Hemerocallis.**
13. **Hippeastrum (Kmight's Star Lily).**
14. **Hyacinth.**
15. **Hymenocallis.**
16. **Ixia.**
17. **Liliums.**
18. **Narcissus.**
19. **Nerine Japonica.**
20. **Onion.**
21. **Pancratium.**
22. **Tuberose.**
23. **Zephyranthes.**

CUTTING OF INDIVIDUAL TUBER OR RHIZOME INTO MINOR PARTS.

This is done in tubers like those of Potato, or Rhizomes like those of Alocasia, at a time the tubers have fully finished their growth for the season, and are at "rest". Unlike Dahlia tubers, the buds or eyes of Potatoes, are distributed throughout their body. So that if a potato tuber is cut in piecee, and put in ground during month of October and November in the Plains of India, plants will grow almost from every such cut portion of the tuber. New tubers will grow at the bottom of every plant in due course. Similarly plants like Alocasia can be easily multiplied if their rhizomous parts are cut into pieces and put either in ground or in pots in months of March and April. Fresh plants will grow during the commencement of the next Rainy Season. Such plants will admit of a very ready propagation in this way at all seasons of the year, but much more readily during rains. Underneath, I give a List of plants which are generally multiplied in this way.

LIST OF PLANTS PROPAGATED BY CUTTING OF THEIR RHIZOMES OR BULBS.

1. **Alocasia.**
2. **Anthurium.**
3. **Diaffenbachia.**
4. **Alpinia.**
5. **Cactus.**
6. **Canna.**
7. **Ginger.**
8. **Gloxinia.**

9. **Iris.**
10. **Phyllotanium.**
11. **Pardanthus.**
12. **Pothos.**
13. **Potato.**
14. **Schimatoglottis.**
15. **Turmeric.**

&c. &c.

Printed by J. BANERJEA
THE LAWRENCE PRINTING WORKS
3, Ramaprosad Roy Lane, Calcutta.